

**PATENT**

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**SPEAKER RESONANCE VOICEBOX**

Background

5 The disclosures herein relate generally to a computer system and more particularly to a speaker in a computer chassis.

10 When a speaker is mounted inside a computer chassis without a speaker box, the resulting sound performance is poor due to the speaker sound energy being radiated inward and outward of the chassis. When a speaker box with a flat rear wall is employed to solve this problem, the reflected sound off the flat rear wall will have one base resonance frequency, causing a peak in the perceived speaker volume as the driving frequency increases.

15 Currently, a common approach to this problem is to use a soft material, such as foam, on the rear wall of the speaker box in order to reflect the sound back at various frequencies. This solution does vary the natural responses and avoids a peak in the perceived speaker volume, but it also absorbs overall sound energy  
20 which reduces sound quality and is relatively costly.

25 Therefore, what is needed is a speaker box that varies the natural responses and avoids a peak in the perceived speaker volume, but does not absorb sound energy and is less costly to manufacture.

Summary

One embodiment, accordingly, provides multiple resonant frequency lengths between the speaker and a hard reflecting surface. To this end, a speaker  
5 apparatus includes a speaker and an acoustic box connected to the speaker. The box has a sound reflecting distal wall including a plurality of stepped portions of variable distances from the speaker.

A principle advantage of this embodiment is that it retains the advantages of  
10 a hard reflecting surface while being less costly than attaching a soft material to the rear speaker box wall. The stepped multi-leveled rear wall spreads the natural responses of the speaker and avoids a peak in the perceived speaker volume without absorbing as much sound energy as a soft material attached to the back of the speaker box.

Brief Description of the Drawings

Fig. 1 is a diagrammatic view illustrating an embodiment of a computer  
20 system.

Fig. 2 is a perspective view illustrating an embodiment of an acoustic box.

Fig. 3 is a perspective view illustrating an embodiment of the acoustic box  
25 having a speaker mounted therein.

Fig. 4 is a partial perspective view illustrating the acoustic box and the  
speaker.

Fig. 5 is a cross-sectional side view illustrating the acoustic box and the  
30 speaker.

Figs. 6A and 6B are views illustrating the speaker and the acoustic box  
mounted in a computer chassis.

Fig. 7 is a graph illustrating a natural frequency response of an acoustic box having a reflecting distal wall that is flat.

Fig. 8 is a graph illustrating the natural frequency response of the acoustic box having a sound reflecting distal wall including a plurality of stepped portions of variable distances from the speaker.

### Detailed Description

In one embodiment, a computer system 10, Fig. 1, includes a microprocessor 12, which is connected to a bus 14. Bus 14 serves as a connection between microprocessor 12 and other components of computer system 10. An input system 16 is coupled to microprocessor 12 to provide input to microprocessor 12. Examples of input devices include keyboards, touchscreens, and pointing devices such as mice, trackballs and trackpads. Programs and data are stored on a mass storage device 18, which is coupled to microprocessor 12. Storage devices include such devices as hard disks, optical disks, magneto-optical drives, floppy drives and the like. Computer system 10 further includes a display 20, which is coupled to microprocessor 12 by a video controller 22. A system memory 24 is coupled to microprocessor 12 to provide the microprocessor with fast storage to facilitate execution of computer programs by microprocessor 12. It should be understood that other busses and intermediate circuits can be deployed between the components described above and microprocessor 12 to facilitate interconnection between the components and the microprocessor.

An acoustic box 26, Fig. 2, includes a plurality of chassis mounting tabs 28, a chassis mounting clip 30, a speaker wire exit opening 32, a plurality of speaker mounting ledges 34, two of which are shown, a plurality of speaker retention tabs 36, two of which are shown, and a sound reflecting distal wall 38.

As illustrated, two ledges 34 are visible on one side of box 26. However, two additional ledges are also provided but are not in view in Fig. 2. The additional ledges are opposite the two illustrated ledges. Similarly, two retention tabs 36 are

visible on the one side of box 26. Two additional retention tabs are opposite the visible tabs and are not in view in Fig. 2.

Mounting clip 30 includes a flexible arm 30a, a release tab 30b and a locking tab 30c. Locking tab is provided to engage a chassis on which the box 26 is mounted, to be discussed below.

Fig. 3, 4, and 5 illustrate the acoustic box 26, connected to a speaker 40. When assembled with acoustic box 26, each corner of speaker 40 sits on a speaker-mounting ledge 34. Speaker 40 is held in place by a snap-fit engagement with speaker retention tabs 36. Fig. 5 also shows a side profile of the sound reflecting distal wall 38, which has a plurality of stepped portions, each portion being of a different distance from the speaker than each other stepped portion.

Wall 38 includes the plurality of stepped portions, for example, portions 38a, 38b, 38c, 38d and 38e. Each of the portions 38a-e are substantially flat or planar and are substantially parallel to speaker 40. However, no two of the portions 38a-e are of equal distance from the speaker 40. For example, portions 38a-e are spaced from speaker 40 at respective distances D1-D5. The distance D1 is least distance, D2 is greater than D1, D3 is greater than D2, D4 is greater than D3 and D5 is greater than D4.

Most components of computer system 10 are mounted inside a chassis 42, Figs. 6A and 6B. The speaker 40, connected to the acoustic box 26 as discussed above, can be mounted inside chassis 42. The chassis mounting tabs 28 mount tightly to chassis 42 through a set of speaker mounting slots 44, Fig. 6B. Locking tab 30c engages with mounting clip opening 46 to hold the speaker 40/acoustic box 26 assembly in place.

Chassis mounting tabs 28 are seated in slots 44. Acoustic box 26, containing speaker 40 is slidably moved relative to chassis 42 so that tabs 28 are locked into slots 44 and locking tab 30c of mounting clip 30 snaps into position and extends through clip opening 46. As a result, the acoustic box 26 is retained on chassis 42. When it is desired to remove box 26 from chassis 42, mounting clip 30 is flexed to

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withdraw locking tab from clip opening 46 and tabs 28 are free to slide in slots 44 to a position where box 26 may be separated from chassis 42.

Fig. 7 is a graph of the resonant frequency of a speaker/acoustic box assembly that has a sound reflecting distal wall that is a constant distance from the speaker, as disclosed in prior art assemblies of this type. The maximum in the curve results in a peak in the perceived speaker volume as the driving frequency is increased, which is an undesirable characteristic.

Fig. 8 is a graph of the resonant frequency of the speaker/acoustic box assembly, in accordance with the present disclosure with a sound reflecting distal wall the has a plurality of stepped portions, each portion being of a different distance from the speaker than each other stepped portion. Each stepped portion of the distal wall shows a maximum in its curve as the driving frequency is increased. However, because the stepped portions of the distal wall are all at different distances from the speaker, these maxima are spread out over a range of driving frequencies. The resulting distributed curve, Fig. 8, shows how this design smoothes out the natural response range of the speaker/acoustic box assembly.

As can be seen, the principal advantages of these embodiments are that the stepped voice box offers multiple resonant frequency lengths between the speaker and reflecting surface without soft media thus smoothing out the natural resonance range while maintaining the advantage of a hard reflecting surface. This approach also has a lower cost than a soft surface that must be mounted to a hard frame or box. The perceived overall increase in sound quality and volume is prominent.

Ins. 2  
Although illustrative embodiments have been shown and described, a wide range of modification, change and substitution is contemplated in the foregoing disclosure and in some instances, some features of the embodiment may be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the embodiments disclosed herein.